Test Video Selection for Video Research and Development

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Introduction

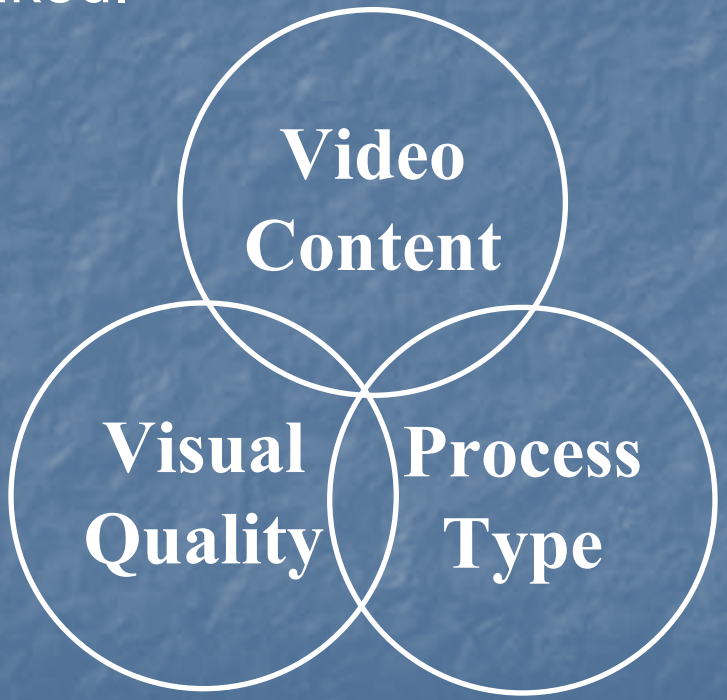
- CE video R&D involves a rigid work flow.
- Consistent / repeatable validation is required at all stages.
- Test content must be selected under strict guidelines.
- A complex problem:
  - No existing standards for guidance.
  - Lack of expertise in selection of test videos.
  - Lack of available videos.
  - Relevancy of selected videos questionable.

Introduction

- Create difficulties in benchmarking and comparison of new technologies and products including:
  - Delays in communicating ideas.
  - Difficulties in comparing results.
    - Results repeatable?
  - Errors not discovered.

Video R&D

- Three fundamental criteria, video content, visual quality, and process type.
- Intrinsically linked.



Video R&D

- **Video Content** is the need to use a complete and representative set for the purpose of validation.
- **Process Type** is the need to consider the application under study and the processing chain involved.
- **Visual Quality** is the need to evaluate the algorithm with tests that check for subjective visual quality and include subjective or objective metrics.

CDVL

- Out solution is the Consumer Digital Video Library.
- Goals include
  - A repository of standardized test video content that are publicly available and free from copyrights,
  - Videos to be contributed by researchers and industry.
  - A set of usage rules to guide R&D validation.
- We focus on usage rules that will guide test video selection.

Usage Rules

- Usage rules required to define a framework for test video content selection.
- The main factors that parameterize usage rules include:
  - Process type.
  - Developmental stage.
  - Validation type.

Process Type

- Three main categories of **Processes**:
  - Corrective (attenuation of defects).
  - Enhancement (increase visual quality).
  - Conditioning (conversion between formats).
- No single video or test pattern can be used effectively across all categories. Must be based on process type.
- Two important points of note
  - Content Requirement.
  - Performance Criteria.

Process Type

- Content Requirement
  - Corrective - medium to high spatial, temporal, and color complexities, with outdoor scenes with textures/details, and close-ups of people.
  - Enhancement - high spatial and color complexity combined with low to medium temporal complexity.
  - Conditioning - high spatial and color complexity combined with low to high temporal complexity.

Process Type

- Performance criterion
  - Visual confirmation without introducing new annoyance factors.
  - For correction and enhancement, the processed image must be preferred at a specified level in a subjective test. Expert tests to corroborate effectiveness.
  - For conditioning, visual confirmation of the processing should look for the retention of proper motion portrayal and color integrity and that small objects in the video content should not be removed by the processing.

Developmental Stages

- There are 3 fundamental stages in video R&D:
  - Exploration (conceptualization), prototyping (proof of concept).
  - Integration (to ensure that algorithm works as part of a larger system).
  - Production (system verification before deployment).
- Each stage have different requirements.
- Videos must be selected appropriately.

Test Type

- Two main types of validation tests
  - **Subjective** – involves psychophysical experiments that evaluate the effectiveness of an algorithm with human subjects
  - **Objective** – metric based tests where processed videos are measured using a metric and benchmarked. These objective metrics may consist of traditional metrics such as PSNR or metrics designed to correlate well with the human visual system (HVS).

Content Descriptors

- Content descriptors facilitate categorization of videos.
- Descriptors can then be used in the selection of video content with the usage rules as a guide.
- Three basic descriptors defined are:
  - Color richness – Colorfulness or vividness of the color content.
  - Spatial complexity – Busyness, texture, strength and prevalence of edges.
  - Temporal complexity – Motion complexity and speed.

Content Descriptors

- Color richness
  - product of σ of the three axes, L*, u*, v* in the CIE 1976 (L*u*v*) color–space.
- Spatial complexity
  - combination of entropy, a blurriness metric, and a spatial activity metric
- Temporal complexity
  - product of mean, median, standard deviation, and maximum value after removing the top 5% of the motion vector magnitudes

Remarks

- There is a need for a standardize suite of test videos that are freely available to all and the usage modes.
- Collaboration is necessary to determine the criteria for such a suite of videos.
- The CDVL aims to offer:
  - A source of videos appropriate for R&D.
  - A set of usage rules for content selection.
  - A central location to share ideas.
- Partnerships with content providers, algorithm researchers, and equipment providers are being pursued.

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to be moved in the near future to
www.cdvl.org